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ABSTRACT

Through dynamic aquatic stabilization techniques, patients will develop the ability to characterize sensory distractions and develop self-awareness and sensitivity to movement in the water, which will relate directly to improved motor function. Aquatic therapy is a systematic method of treatment, with programs developed by a licensed physical therapist, used to improve the patient's ability to learn lifelong exercise skills. If patients do not learn to distinguish one state of feeling from another, they may be left merely to repeat the same patterns of dysfunctional movements again and again. Aquatic stabilization skills are taught in a supervised surrounding and in an instructional manner. They are intended to correct posture, while increasing strength, flexibility, range of motion, and endurance, for a lifespan wellness program. Aquatic therapists must consider minimizing their liability by prevention and education. Two appendixes provide an illustration of the Nachemson Studies on both everyday and exercise positions and on training needed for supervising aquatic exercise and aquatic therapy. (Author/LL)

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What's New:
Aquatic Stabilization:
Aquatic Rehabilitation Strategies for the Lumbar Spine
and
Risk Management for the Aquatic Therapist

Abstract

Through dynamic aquatic stabilization techniques, patients will develop the ability to characterize sensory distractions, develop self-awareness and sensitivity to movement in the water, which will relate directly to improved motor function.

By unloading the spine in a gravity free environment, aided by water's buoyancy and resistance, patients will be taught to develop the capacity to discern differences in dynamic movement to hold their "position of function".

Aquatic therapy is a systematic methodof treatment, with programs developed by a licensed physical therapist, used to improve the patient's ability to learn life long exercise skills. If patients do not learn to distinguish one state of feeling from another, they may be left to merely repeat the same patterns of dysfunctional movements again and again. Aquatic stabilization skills are taught in a supervised surrounding using an instructional manner, correcting posture, while increasing strength, flexibility, range of motion and endurance, for a lifespan wellness program.

Risk Management for the aquatic therapist who has no background in aquatic safety methods is at high risk for potential litigation, if the facility at which services are being provided prove unsafe.

DISCUSSION:

Pain is one of the most common reasons for seeing a doctor. It is an equal-opportunity affliction. It spares no one on the basis of race, creed, color, or sex. Each year 65 million people suffer from low back pain alone (Gracovetsky, 1986).

Lack of physical activity is one reason humans have back, neck or other pain in the joints or muscles of the body. Too much, or too little exercise or over-exertion, disease or excess weight are also reasons we suffer pain (Panjabi, 1988).

A physician may refer an individual suffering back pain to physical therapy for evaluation and measurements of neuromuscular and musculoskeletal functions (Hill, 1988). Treatment is administered using agents such as therapeutic exercise, aquatic therapy, massage, mechanical devices, also physical, chemical, or other properties of air, electricity, sound or radiant energy. Program implementation to facilitate healing is directed appropriately utilizing motivating instruction to further patient progress, thus furthering measured functional strength gains (Harrison, 1980). Aquatic therapy is one method of treatment to employed re-educate the patient toward realizing their goals.

In the aquatic environment, diminished axial loading, decreased movement velocity, reduced gravitational force along with water's resistance are used in combination to reach functional goals (Cole, 1990). Combining both a dry physical therapy program of stabilization, such as the program developed at SpineCare Medical Group in Daly City, California, and aquatic therapy enhances the potential to return the patient to their prior activity. A combination of these two regements will establish supportive new activities and possibly eliminate risks associated with some types of traditional methods of treatment Saal, 1987). When a physician refers to aquatic therapy, the patient may not be able to tolerate axial loading, or gravitational loads and may need increased support for strength

and proprioceptive deficits. The traditional dry program of therapy might exacerbate the patient's symptoms, or there may be an exclusive preference for aquatic medium treatment.

Using the environmental interaction between both wet and dry programs will allow the transference of stabilization skills, cross-training for strength and proprioception and preparation for endurance training, for increased functional activities of daily living (Cole, 1990).

The purpose of aquatic stabilization is to eliminate segmental movement, reinforce lumbar control, encourage hip, knee and ankle propulsion, head and neck stability, and establish arm control and strength (Cole, 1990). Important to any treatment is a complete patient history, including onset and course of treatment, medical management, and physical management of stabilization programs. Swimming skills do not determine whether a person will be a successful candidate for aquatic therapy, as swim stroke proficiency is not a model for success.

Specific exercise techniques in both aquatic and dry stabilization programs are derived from a framework of evidence relative to the forces acting on the spine segments. These forces are compression, rotation, flexion, extension, ligament tension, sheer, creep, and torque (White, 1978). The disc is a water holding structure, and is considered cartilage connective tissue (Saal, J, 1988). The outer structure of the disc called the annulus, relies on a supply of a chemical called protoglycian. If that supply is interrupted, the disc can swell 250 times and cause inflammation to the surrounding structures. The water content of the disc is 90% at the age of 30. By the age of 65 the annulus of the disc is 65% water . The inner and outer annulus hold the protoglycians, which in turn keep the water in the disc. When the degenerative process begins, small tearing of the annulus allows the chemical balance to be disrupted, water to leak out of the disc, allowing the disc space between the vertebra to close and become smaller. The nerve roots and central canal sac of the nerve innervating the structure become irritated and back pain results (Saal, 1988). Other factors also play a part in the physical forces.

It has been determined that the human spinal column, devoid of musculature is incapable of carrying loads imposed on it past 4.4 pounds before it buckles and becomes unstable. In the Panjabi studies (1989), they found that the role in maintaining spinal stability was due to intersegmental spinal muscles playing a greater role than the superficial muscle groups. These include the multifidus, interspinalis and rotator muscle groups. The closer relationship to the centers of rotation of the spinal movement and adjacent vertebra show these smaller muscles are better suited to control axial rotation. Axial rotation should not exceed 5-6 degrees. If rotation exceed this amount, the facet joints and lumbar segments above and below the ligamental supporting structures stretch beyond a safe biomechanical limit (Paris, 1985). Even though the superficial muscles are bigger, exert larger forces, have longer lever arms, and produce greater bending moments, they do not play the major role of stabilization. The superficial muscles of the back, because of their size are better adapted to counterbalance external loads needed for achieving overall spinal posture and movement.

In separate earlier studies, Nachemson showed that intradiscal pressures vary in different functional positions and activities. Some of the functional positions examined include: recumbent side-lying, supine lying, sitting, standing, forward flexion, forward flexion with a load, and forward flexion in the sitting position with a five pound load. By injecting a needle into the disc, Nachemson tested the lumbar level of the third vertebra and disc. The intradiscal pressures measured showed seated forward flexion in combination with a five pound load creates an increase of 275 times the pressure than the same segment in a reclining position. (Nachemson, 1974). When rotation is added in this position, the

small stabilizing muscles cannot hold their position, and discal herniation may occur. (Appendix A) The cumulative studies have drawn the frame work for todays lumbar stabilization techniques.

Dr. William Kirkaldy-Willis coined the term "Degenerative Cascade," a natural process of the spine's [physical] downward spiral that leads to back pain (Kirkaldy-Willis, 1983). The Degenerative Cascade has five phases, beginning with the instability phase. Back pain symptoms vary in the phase, which shows signs of abnormal laxity in the motion segment. The stability phase shows a loss of motion and a combination of stenosis in the lateral and central motion segment. The third change show signs of the vetebral disc breaking down with small circumferental tears around the annulus and progressive loss of disc space height with lateral and central canal stenosis. In the fourth phase facet changes begin with excessive rotational strain and compressive force, with the facet showing signs of synovitis and articular cartilage loss,which is followed by the joint space narrowing. The fifth phase includes soft tissue changes in which nerve root scarring, ligament elasticity loss and chemical changes all affect the motion segments (Saal, 1988). Physicians clinical findings have shown that our posture and anatomy create chemical changes within the motion segments that begin to spiral downward even in young children. Studies are being done to learn how to prevent early onset of "bad back" behavior and assess the risks posed by the natural degenerative process (Saal, 1988). It is known that when standing the motion segment of the fourth lumbar vertebra shows the anterior disc pressure is 80%, and there is 20% pressure on the posterior portion. When in the sitting position with the spine in the flexed position, the anterior portion is 90% and the posterior portion is 10%. However, in the degenerative spine the balance between segments is 50% - 50% anterior/posterior.

The spine has six degrees of movement (White, 1978). The vetebral bodies in these positions assist the range of motion as we move through activities of daily living. The movements are:

1. Compression/distraction
2. Forward, backward
3. Laterally, or gliding motion
4. Forward/backward tilt, as in flexion and extension
5. Lateral tilting in a frontal plane,
6. Rotation on a horizontal plane around an axis.

Rotation is a spinning or angular displacement of a mass about a fixed axis. Whereas shear is a posterior/anterior stress applied to an intervertebral body, or a sliding between two discs. Compression in combination with rotation, flexion or torque create a stress loading that is greater than the control muscular variables can withstand. When support and stability are primary goals. There is a need to eliminate sheer and rotational forces to accomplish pelvic stabilization (Saal, 1988). Clinical challenges on an individual basis are combined with functional, measurable strength goals for patient rehabilitation of a spinal injury.

Pelvic stabilization is a resolution of problems stemming from shear, force, torsion, compression, and are accomplished by using the muscle fusion concept to increase strength, flexibility and improve posture. Pelvic neutral can be achieved through training the lumbar dorsal fascia to form a dynamic corset by strengthening the abdominal obliques and the pelvic girdle muscles.

STABILIZATION METHOD: Supine Recumbent and Vertical

Using the floor as a gravity guide, position the body comfortably in the recumbent supine position. Bend the knees up and place the feet flat on the floor. The arms should be at the sides, palms of the hands upward. The eyes should be closed, and breathing slowed to a relaxing, deep rhythm. Place the hands on the stomach, and breath deeply 5 times. Palpate the anterior superior iliac crests bilaterally. Palpate the sacrum while in the supine position. Think of the pelvis as a compass while the body is resting on the floor . The Northern or proximal part of the compass is just below the zyphoid process located between the rib cage. The Southern end or distal part of the compass is at the top of the pubis symphysis. The West side of the compass is on the right iliac crest, and the East side on the left iliac crest. Place the middle fingers of both hands on the right and left iliac crests, and the thumbs on the seventh and eighth mid-ribs. Visually measure the distance between these two points. As the weight of the body is felt, turn to the feeling of the pelvic compass.

Gently and slowly begin to lift the Northern end of the compass or the rib cage, inhaling deeply with the movement. The Southern portion of the compass is slightly arched and the movement is subtle as the change is made between North and South. Feel the gravitational pressure points along the sacrum and pelvic bone while your hands feel the adjustment between the pelvis and ribs as they change with the movement. The space between the rib cage and iliac crest expand and recess as movement is made North and South. This is the pelvic tilt. Movement should be made in small rolling millimeter proportions. Roll gently from East to West, by slightly lifting up the right then the left hip. What is accomplished by performing these simple pelvic exercises is awareness of the position of the pelvis, how the pelvis is resting on the floor, and how the movement feels performing a small range of motion. Once the most pain-free dynamic range is established, then the patient should be instructed to gently contract their buttock and abdominal muscles as a unit. This forms the pelvic muscular corset enabling dynamic stabilization in the vertical position.

To establish standing or vertical dynamic lumbar stabilization, a technique called vertical loading is used. This is done by vertically standing the patient with their feet placed at shoulder width. The therapist assumes a position behind the patient, and places his hands at the patients shoulders, pressing down with a medium amount of pressure. If the pelvis is not in the correct position, the pelvis, spine and knees are placed in an unstable position, and will buckle forward. The pelvis is shaped like a bowl. A plum line could be used to establish the center of gravity. In most people this point is located approximately at the second sacral joint.

The objective of this exercise for the patient is to find the most comfortable, pain free standing position, that will enhance correct posture. The concept of neuromuscular re-education is used to instruct the patient in correct postural and functional movement while in the dynamic stabilized position. The following information is used by a therapist to establish an early visual and tactile feed-back system.

Observe the stance of the patient as they are instructed to assume the following position:.

1. Feet should be shoulder width apart
2. Each foot should be slightly pointed out to the side
3. Knee joint should be unlocked

4. Shoulders should be down and relaxed
5. Hands should have the palms touching the body, thumbs forward
6. Chin should be slightly tucked
7. Crown of the head elevated

Visualize the bottom of both feet as a triangle, with the apex at the mid-metatarsal joint of the third toe, and the bottom two angles cutting a line across the mid-longitudinal arch. The body weight should be resting equally on both feet and the therapist should position the patient's body as follows:

1. With the feet placed at shoulder width position, toes pointed slightly out, shift the weight of the body forward to the toes and back to the heels in a gentle rocking movement.

2. Position the body weight at the position between mid- arch and the ball of the foot, and relax in this position.

3. Unlock the knee joints.

4. Position the tips of the fingers on the iliac crest, and thumbs on the mid-ribs.

5. Find pelvic neutral, using the pelvic tilt method of slowly rolling the pelvic compass North then South feeling for the comfortable neutral zone in the standing position.

6. Contract the abdominal and pelvic muscles by slowly squeezing them, forming the pelvic girdle.

7. Look down at the feet, just slightly tilting the head down. While feeling the body in this position, look up so the visual field is approximately 10 feet straight ahead.

8. Breath deeply, and let the arms lower to the extended position.

9. Relax the extremities, but keep the pelvic corset muscles contracted.

The person testing for correct postural position should now attempt the vertical loading technique, as the patient remains in the stabilized vertical position. The corset of contracted pelvic muscles should hold the patient in absolute solid position, as the tester attempts to dislodge the stable base. All future functional movement should be attempted from this solid stabilized base in order for the patient to utilize the concept of true stabilization.

DRY TO WET - AQUATIC STABILIZATION

Water neutralizes gravity and gives buoyancy, allowing the body when placed in water to seemingly be in an imaginary cocoon. Dynamic pelvic stabilization in water is more difficult to feel because proprioception is disrupted by pressure neuroreceptors (Cole, 1990). Additionally, water temperature, refraction, and water pressure disrupt proprioception. Tactile feedback through the kinematic chain is necessary to assist rehabilitation of proprioception through the foot, neck and optic reflexes. Visual cueing and a specific set of vocabulary words are an instructional necessity to help the patient learn

sensory and motor controls and highlight directional differences from dry gravity loaded exercise. For this reason, a dual program of dry land and aquatic therapy rehabilitation technology seem best for the early re-education of the patient. Back school, an educational program, is utilized to establish correct activities of daily living such as: sitting, bending and dressing, sweeping, tooth brushing, sneezing, all taught in the dry clinical setting. Entry level pelvic stabilization methods are also instructed at this time. The patient may then be introduced to the pool stabilization program.

Aquatic Therapy's Golden Rule:

From Dry To Wet, They Will Forget

Preparation of the patient is important prior to actual pool treatment so they will understand the feeling of water's physical properties, particularly buoyancy and resistance. Entering the pool, handling gear, stooping and bending while dressing, and type of water entry need to be addressed so the patient will have a complete understanding of their posture, and remember the aquatic "golden rule." The patient needs to be remained to stay in the dynamic pelvic stabilized position. Initial evaluation in the pool can be accomplished by the technician viewing the patient underwater, utilizing a snorkel and mask to enforce concepts.

AQUATIC THERAPY TREATMENT METHODS

Aquatic activities can be selected based on the following protocol:

1. Activity selected
2. Type of support used
3. Position of the body in the pool
4. Active segment - upper or lower extremities - trunk, or both
5. Movement of the body - static, bilateral, unilateral, reciprocal
6. Variables
7. Level of Conditioning Based on Stage of Disability

The features of the aquatic stabilization concept are:

1. Activity mode are based on direct supporting contact with a solid device, usually the pool wall, and exercises can be performed in the sitting or standing position.

2. Positions vary from vertical, supine, prone or side-lying

3. The active segment being the upper body, lower body, both segments of the upper and lower body, and the trunk.

4. Movement in these positions are static, bilateral, reciprocal, or unilateral.

5. Variables in aquatic technology are based on whether weight is used, the speed of movement, type of resistance, the length of the lever arm, depth of the body, direction of movement, whether time and /or endurance is used to measure gains, type of equipment used, temperature of the water in which the patient is exercising.

7. Activity is also performed in a semi-supported position, and can be either standing, or floating with a therapist and/or device. All positions, active segments, movement, and variables may be selected as part of the treatment. Locomotion is accomplished in a vertical, prone or supine position.

8. In the final mode the patient uses is the unsupported element where independent locomotion is selected, usually in a traditional swimming position with all variables available for application.

In order to provide the licensed physical therapist with the appropriate training necessary to facilitate aquatic therapy technology, workshops are conducted to give specific instruction in various methods of treatment for various protocols, such as: orthopedic, neurologic, post-stroke, hip replacement, cardiac, and spine stabilization, shoulder and knee surgery. Para-professional personnel that have an educational background in aquatics, dance, kinesiology, athletic training, exercise physiology, pedagogy, all may make up the staff necessary to implement treatment in a clinical setting. The physical educator and/or water exercise instructor needs to know the difference between recreation services and therapy and where to draw the line between those services (Appendix B). All personnel in a clinical setting must be supervised by a licensed physical therapist on the site where services are rendered: hospital, rehabilitation hospital, private clinic or leased pool site .

When the physician selects aquatic therapy as a method of treatment, the licensed physical therapist may begin a phased program based on the functional level of the patient. Levels of function are based on the patients ability to perform exercise for given periods based on variables chosen and performance graded by range of motion and muscle strength tests.

RISK MANAGEMENT IN AQUATIC THERAPY

As of Spring 1991, most physical therapy schools in the United States do not have aquatic therapy in their curriculum. The American Physical Therapy Association is attempting to quantify an aquatic section by the end of 1991. While there seems to be an attempt to establish specific treatment protocols in the aquatic therapy industry, one area over looked is risk management in the physical therapy practice.

Standards of established aquatic safety are available through training institutes throughout the United States. The Red Cross, Ellis & Associates, YMCA, and others provide specialized training in lifeguard, and basic rescue techniques. Many physical therapists want to offer their patients aquatic therapy because many physicians are referring for treatment. But the majority of physical therapists have no training in aquatic safety. In order to provide safe, effective treatment, therapists must consider minimizing their liability by prevention and education.

Effective supervision in and around the pool includes having at least one staff person become a certified lifeguard, and all staff should hold current CPR and advanced first aid certificates. **Each facility should conduct a safety inspection, which may include the following**:

Water clarity
Ventilation Lighting
Emergency evacuation plan
Deck surfaces
Deck equipment

Access for emergency entrance and exits
Rescue equipment
Telephone access
Posted pool rules
Diving signs
Depth markings
Permit to operate
Adequate barriers
Chemical storage sheets
Detailed maintenance checklists
Labels for all doors and machine operation
Safety gear for use in emergency chemical exposure
Lifeguard supervision during all hours of operation
Compliance of Uniform Fire Code
EPA SARA, Agriculture Pesticide Safety Training, OSHA chemical standards
Maintainence of chlorine or other specific sanitizing method at appropriate levels
Locker room safety
Sanitation methods that concur with high personal hygiene (Osinski, 1988).

Additional items include: waiver, release and indemnity agreement for patient to sign; acknowledgement of patient compliance of facility's general pool rules; aquatic department accident and incident reports filled out immediately after incident; confidential medical questionnaire filled out by patient filed in chart; confidential medical statement from physician signed, dated and filed in chart.

The facility should observe the following rules as a minimum:

1. Ideally, each person on the staff should know how to swim well enough to survive in an emergency

2. The pool should be supervised at all times

3. Safety rules should be posted

4. Staff should conduct "red shirt drills", which are simulated emergency procedures

5. Staff should know the swimming limitations of all patients and not substitute an inflated device for their ability to swim

6. Install an emergency telephone response system on pool site

7. Clearly label all emergency exit paths

8. Secure toxic chemicals in a well-ventilated area

9. Keep a well-stocked first aid kit on or near the pool deck

10. Keep the pool deck and dressing areas free of excess water

11. Be sure that all benches, chairs, toilet seats and equipment are in good working order

12. Be sure that all means of entering the pool via stair, ramps or ladders are not obstructed by equipment

13. Keep first aid and rescue equipment on or near deck

14. Have written procedures for emergencys filed with the insurance company

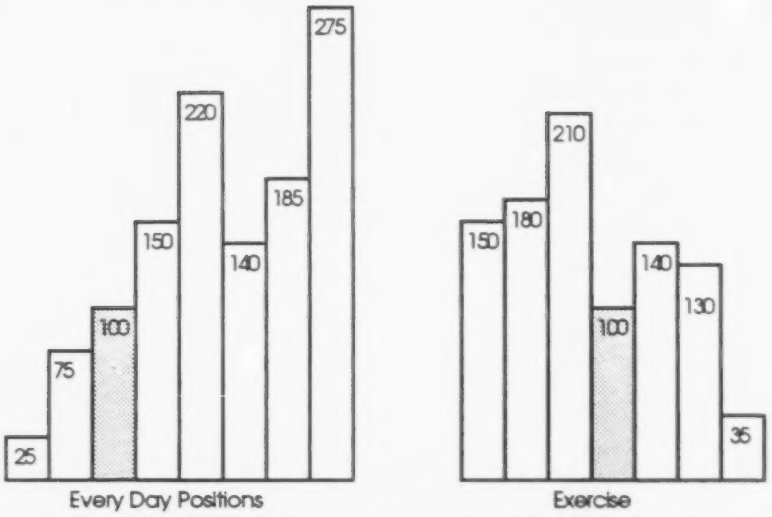
15. Pay liability insurance premiums, and keep policy current

CONCLUSION

Aquatic therapy stabilization methods for the rehabilitation of the lumbar spine, provide a mode of treatment that patients find beneficial, and provides a means of increasing and maintaining functional strength goals. The traditional "cookbook" protocols found in dry land therapy do not apply in aquatic therapy because of the variety of methodology available to the technician. Physical educators and recreation water exercise instructors need to be aware of anatomy, range of motion and limitations of the spine should patients be referred by a physician attend their classes. No recreation aquatic specialist should treat a person with a lumbar, cervical, or other injury, without specific supervision by a licensed physical therapist. Specific aquatic therapy programs should be developed by licensed physical therapists, physicians, chiropractors or surgeons to meet patients goals and provide the safest, most effective method of treatment in the safest physical environment possible.

Appendix A

Illustration of the Nachemson Studies



Intradiscal Pressures measured in various positions and activities
Adopted from A. Nachemson.

Nachemson, A., Measurement of Intradiscal Pressure, Actarthop. Scand: Suppl. 43.1

Every Day Positions

25=Lying flat surface
75=Side Lying
100=Standing
150=Forward Flexion/straight legs
220=Forward Flexion with 5 lb. weight
140=Sitting
185=Sitting bending forward
275 Sitting bending forwrd picking up 5 lbs

Exercise Positions

150=Lying flat on back/hip flexion 50 degrees
180-Prone lying with legs at 35 degrees extension
210=Curling sit -up
100=Standing
140=Supine with hip/kjnee flexion with compression applied to knees
130=Supine lying with leg extension/compression applied to ankles

35=Supine lying with back flat, hip flexion/lower legs resting on bench

Appendix B

WHERE TO DRAW THE LINE

Aquatic Exercise	Aquatic Therapy
RECREATION	THERAPY
Certification	**Pysical Therapy License Required**
Regulation is not mandatory in industry Possible : WSI, Lifeguard, CPR, 1st aid may be required in future	National Regulatory Board and State licensing boards set standards, Master's degree and 2-3 year professional educational training required
Fitness Assessments	**Physician Referral Required**
Cardiovascular Fat/Lean ratios Set-up exercise programs not prescriptions	Goals, diagnosis, frequency, duration are set by physicians , and therapists
Basic Knowledge	**Medical Tests Performed**
Kinesiology Physiology Anatomy Safety Emergency rescue, not required CPR First aid	X-rays, CT scans, MRI
Most of the above are given in one or two day certification trainings, which may not require higher level education screening, or lifeguard or aquatic safety skills	**Therapist/physician Sets Patient Goals** Assesment of clinical functional capacity Therapist does work-up for specific program in clinical setting Choice of exercise technique
Non-Clinical	**Modalities** Heat, ice, massage, modalities, exercise prescription, aquatic therapy
Learn what NOT to do with participant	**Clinical Setting**
Classes held in conjunction with recreation departments, private clubs, YMCA's	Professional responsibility Part of medical team Doctor/,therapist/,athletic trainer, workers' compensation adjustor, attorney, volcational counselor
Assessment	**Assessment**
Recreation value agreeable and enjoyable pastime exercise, with lifespan fitness goals	Purposeful goals, i.e., working towards measurable gains in function, strength, range of motion

REFERENCES

ABIDIN, L., Lombardi, D., Devlin, W. Thacker, S., Edlich S. (July, 1988) A new hydrofitness device for strengthening muscles of the upper extremity. JBCR, 9, 402-406.

ADAMS, M.A., Hutton, W.C. (March, 1983) The Effect of Fatigue on the Lumbar Vertebral Disk. JBJS, Vol. 65B, #2.

ADAMS, M.A., Hutton WC, Stutt, J: (1981). The resistance to flexion of the lumbar intervertebral joint. Presented in Paris at the meeting of The International Society for Study of the Lumbar Spine.

ADRIAN, M. (1987) Kinetics and Heart Rate Responses of Suspended Deep Water Running and Non-Suspended Deep Water Running. Univ. of Illinois, Personal Communication.

ASHCROFT, C., (Jan/Feb 1991) Beating the odds: Risk Management. Clincial Management, 11 , 12-13.

BANGA S., Wolf., (August, 1982) Malpractice litigation for uninformed consent implication for physical therapists. Physical Therapy 67: 1226-1229.

BEASLEY, B. (1989) Aquatic Exercise Prescription Pointers. Sports Medicine Digest, 11: (1) 1-3.

BECKER, D.; Abidin, M.; Lombardi, S.; Phung, D; Shorwell, R; Edlich, R, MD, PhD (July/August 1988) Evaluation of Flotation Devices for Deep-Water Exercise. JBCR,Vol 9, #4, 407-412.

BENNETT, R.L., (1951) Water as a medium for therapeutic exercises. Journal of Medicine, 51: 513.

BOLTON, E. & Goodwin, D. (1956) An Introduction to Pool Exercises. Edinburgh Press.

BURKE, EJ, PhD; Keenan, TJ, MD (December 1984) Energy Cost, Heart Rate, and Perceived Exertion During the Elementary Backstroke. The Physician & Sports Medicine, 12, #12, 75-80.

CAMPBELL, JP (1954) Pool Therapy. British Journal of Physical Medicine 17: 224

Centers for Disease Control. (1998) Swimming Pools: Safety and Disease Control Through Proper Design and Operation. Publication 88 - 8319.

CHOUKROUN, M.L., Varene, P. (April, 1990) Adjustments In Oxygen Transport During Head Out Immersion in Water at Different Temperature. J Appl Physiol 68: 1475-1480.

COLE, A., M.D., Eagleston, R., Martin, L, Moschetti, M. (1990) {Aquatic Therapy: Stabilization Strategies for the Lumbar Spine.} Unpublished raw data.

COLE, A., M.D., Eagleston, R., Sweeney, T., Moschetti, M., Saal, J. (1990) Lumbar Torque: A New Proprioceptive Approach. Unprinted Manuscript.

COLE, L.K., Andres, F (1987) Physiological and Perceptual Responses to Running in the Water. Aquatic Symposium. NSPI. March.

COSTILL, D; Chaill, PJ; Eddy, D. (1967) Metabolic Responses to Submaximal Exercise in Three Water Temperatures. Journal of Applied Physiology, 22: 628-632.

COULTER, J.S., & Piersol, G.M.. (1950) Hydrotherapy: An A.M.A. Handbook of Physical Medicine and Rehabilitation. Philadelphia Press.

DIFFENBACK, L, PT. (1991) Aquatic Therapy Services. Clinical Management , 11, #1, 14-19.

DUFFIELD, M.H. (1983) Exercise in Water. (3rd edition) Philadelphia: W.B. Saunders.

EKBERG, J. (1990) Senior Fitness: Getting into the Swim of Things. Parks & Recreation (2) 46-49.

ELLIS, J. (1989) Consultants for Aquatic Safety. Ellis & Associates. Houston, Texas.

FAIRBANK, D., Couper, J.; Davies, J; O'Brien, M. (Aug, 1980) The Oswestry Low Back Pain Disability Questionnaire. Physiotherapy, 66 (8).

GARVEY, LA, PT. (Jan/Feb, 1991) Spinal Cord Injury and Aquatics. Clinical Management, 11, 21-24.

GREEN, J.H., et. al. (Mar, 1990) Heart Rate and Oxygen Consumption During Walking on Land and in Deep Water. Journal Sports Medicine & Physical Fitness, 30: 49-52.

GOITZ, R.J., Towler, M.A., Buschbacher, L.P., et all (1988) A New Hydrofitness Device for Leg Musculoskeletal Strengthening. Journal of Burn Care Rehab, 9: 203-206.

GRACOVETSKY, S., Ph.D.; Farfan, H., MD. (1984) The Optimum Spine. Spine, 11(6) 543-576.

HALLIDAY, D.; Resnick, R. (1970) Fundamentals of Physics. New York: J. Wiley & Sons, Inc.

HANSSON, T.H.; Keller, T.S.; Panjabi, M.M., Ph.D. (1986) A Study of the Compressive Properties of Lumbar Vertebral Trabeculae: Effects of Tissue Characteristics. Spine, 11, (10) 56-62.

HARALSON, K.M. (1985) Therapeutic Pool Programs. Clinical Management, 5 (2), 10-13.

HARRIS, R. (1958) Hydrotherapy: Is it of Value? Social Medicine, 51: 94.

HARRISON, R.A. (1980) A Quantitative Approach to Strengthening Exercises in the Hydrotherapy Pool. Physiotherapy, 66: 60.

HENRIKSEN, J.D. (Ed.) (1982) Reniassance of Medical Hydrology in Rehabilitation.Proceedings of Fourth World Congress, International Rehabilitation Medical Association. Puerto Rico: p. 138.

HERBERT, Wm.; Herbert, D. (June, 988) Legal Implications of Wellness & Health Promotion Programs. Fitness in Business 2: 210-215.

HIGHSMITH, A.; Kaylor, B.; Calhoun, M. R.N. (Jan/Feb 1991) Microbiology of Therapeutic Water. Clinical Mangement, 11 34-37.

HILL, J. (1988) Physical Properties of Water with Applications for the Aquatic Physical Therapist. Unpublished manuscript.

IWAMOTO, J., et al. (Feb. 1990) Chnges in Insulation of Body Tissue and Wet Suits During Underwater Exercise at Vrious Atmospheric Pressure. J Appl Physiology 68- 659-664.

JACOBS, C.; Loverock. (June, 1990) Taking on Water. Shape 9: 71-78.

JEETER, J., and Kadleck, N. (1985) The Arthritis Book of Water Exercise. New York: Holt Reinhart & Winston.

JOHNSON, B.L., Ph.D.; Strome, S3., Ph.D., Admczyk, J.; Tennoe, K.O. (March, 1977) Comparison of Oxygen Uptake and Heart Rate During exercises on Land and In Water. Physical Therapy, 57 (3)

JONKEY, B.V., Starkweather, M.C. Sharp, D.M. (1987) Pool Therapy: Water as a Medium for Exercise. Unpublished manuscript.

KATZ, J., Most, B.W., M.D. (1985 Exercise: Get in the Swim. Personal Fitness. News America Syndicate)

KATZ, V.L. (April 1990) The Effects of Immersion and Exercise on Prolactin During Pregnancy. EUR J Appl Physiology 60: 191-193.

KIRBY, R.L.; Scamano, J.T.; Balch D.E.; Kriellaars, D.J. (1984) Oxygen Consumptin During Exercise in a Heated Pool. Arch. Physical Medicine Rehabilitation, 65: 21- 23.

KIRKALDY-WILLIS, WM. (1990) Miscellaneous Misconceptions. ABS Newsletter, Vol 6, #4, 1,5.

KIRKALDY-WILLIS, WM. (1985) Presidential Symposium on Instability of the Spine. Presented at the International Society for the Study of the Lumbar Spine, Cambridge, England, April, 1983. Published: Spine, vol. 10, #3, 1985, p. 254.

KOLB, M.E., (1957) Principles of Underwater Exercise. Physical Therapy Review, 37: 361-365.

KOSZUTA, L.E. (April, 1989) From Sweats to Swimsuits: Is Water Exercise the Wave of the Future? The Physician and Sportsmedicine, 17 (4), 203-206.

LOWMAN, C.L.; Roen, S.G. (1957) Therapeutic Indications for Pool Therapy. Physical Therapy Review, 37: 224.

LUBILL, J. (Sept. 1987) Insurance Liability and the American Way of Sport. Physician and Sportsmedicine, 15: 192-198, 200.

MCCARRON, et.al (1987) The Inflammatory Effect of Nucleus Pulposus. Spine, Vol. 12, #8, 760-763.

MCKENZIE, Robin (1988) Treat Your Own Back. New Zealand: Spinal Publications, Ltd.

MEYER, R.I. (Jan/Mar, 1990) Practice Settings for Kinesiotherapy - Aquatics. Clinical Kinesiotherapy 44: 12-13.

NACHEMSON, A. (1960) Lumbar Intradiscal Pressure. Acta Orthop. Supp. 43 Supp: 104.

NACHEMSON, A., Elfstrom, G. (1963) The Influences of Spinal Movement on Lumbar Intradiscal Pressure and On the Tinsil Stresses in the Annulus Fibrosus. Acta Orthop Scand., 3, p.3.

NG, S.C., et al. (1986) Abnormal Connective Tissue Degrading Enzyme Patterns in the Prolapsed Intevertebral Discs. Spine, Vol. 11, #7, 695-701.

OSINSKI, A., Ph.D. (March 1990) Risk Management in Water Fitness. Fitness Management, p. 79.

OSINSKI A., Ph.D. (June, 1988) Legal Responses of Lifeguards. JPERD, 59: 73-75.

PANJABI, M., Ph.D., Abumi, K., MD, Duranceau, J.; Oxland, T. (Feb, 1989) Spinal Stability and Intersegmental Muscle Forces: A Biomechanical Model. Spine, 14 (2), 28-34.

PARIS, S.T. (1985) Physical Signs of Instability. Spine, Vol. 10, #3, 277-279.

ROBERTSON, J.M. (1989) Levels of Satisfied Individuals With Physical Disabilities Experiences in the Participation of Aquatic Activities. Dissertation Abstract: Humanities & Social Science (5) 1436-1437, #DA 8918999.

SAAL, J. (Ed.) (1988) Diagnosis and Treatment of Neuromuscular and Musculoskeletal Syndromes Associated with Low Back Pain: The Degenerative Cascade. San Francisco: SpineCare Institute 2nd annual Back Care Conference, March 1988, San Francisco, CA

SCHULZ, P. (1980) Walking for Rehabilitation: The First Step. The Physician and Sports Medicine, 8 (10) 109-112.

SKALNICK, B. (1976) Aquatic Therapy. Respiratory Therapy, January.

STEVENSON, J., Tacial, J.; Thompson, T.; Crane, J. (1990) Abstract: University of Rochester, MI., A Comparison of Land and Water Exercise Programs for Older Individuals. From: Medicine and Science in Sports and Exercise, May 28.

STOTEAR, W. (March, 1988) The Liability Crises. Dance Exercise Today, 6: 26-28, 30-31.

TRIGGS, M., PT. (Jan/Feb, 1991) Orthopedic Aquatic Therapy. Clinical Management, 11, 30-31.

VICKERY, S.R.; Cureton, Kirk, Ph.D., Langstaff, J.L. (March, 1983) Heart Rate and Energy Expenditure During Aqua Dynamics. The Physician and Sportsmedicine, 11 (3), 67-68m71-72.

WHITE, A..A., Panjabi, M.M. (1978) The Basic Kinematics of the Human Spine. Spine, 3: 12.

WHITE, S.W., Landis, L.M. (Nov/Dec, 1989) Designing Aquatic Exercise Programs: Three Guiding Principles. J PERD 60: 40-42.

WHITLEY, N., Schoene, D. (October, 1987) Comparison of Heart Rate Responses: Water Walking vs. Treadmill Walking. Physical Therapy, 67, #10.

WOODS, D. (Nov/Dec, 1989) Rehab Aquatics for Low Back Injury: Functional Gains or Pain Reduction. Clinical Kinesiology, p. 96-103.

YESSIS, M. (May, 1990) Water Workouts. Mus & Fitness 51: 31.